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CONTENTS

ETIOLOGY OF PERI-IMPLANTITIS

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Abstract: Peri-implantitis is an infection around the body or the apex of the implant followed by less or bigger alveolar bone loss around the implant. This inflammatory process can lead to bone loss and if not treated could lead to the complete loss of the implant-supported prosthodontic restoration. Clinically, the inflammatory process can be presented as bleeding on probing, deepened periodontal pockets and periodontal suppuration. Taking into consideration that peri-implantitis, as an inflammatory condition, can lead to implant loss and consecutively loss of the prosthetic suprastructure worn by the implants, we set out the main aim of this paper - to analyze the latest available literature data concerning the etiology of peri- implantitis. Adequate literature research was performed to fulfill the main goal. Sources of information used in this study are obtained from the most used of all scientific databases- Pub Med. The keywords used for searching in this database were "peri-implantitis etiology", "etiology of peri-implantitis", "peri-implant disease etiology" and "risk factors peri-implantitis". All of the used literature was previously published in peer-reviewed publications and journals. Most of the articles were in English language, published in the last fifteen years from 2004 until 2019. Understanding the etiological and risk factors leads to successful prevention of this late-stage complication. Peri-implantitis can be defined as a poly-microbial anaerobic infection around the body or the apex of the implant. The etiology of peri-implantitis is associated with a complex bacterial dental biofilm and numerous risk factors. All these bacteria from the dental biofilm can establish harmful inflammatory immune response in host and inhibits bone cells reattachment to the implant surface. Microorganisms that are living on the dental implant surface are initial cause of peri-implantitis. Previous periodontal disease, poor oral hygiene, tobacco usage, genetic traits, diabetes, residual cements and occlusal overload are most common noted risk indicators. Other potential risk factors such as osteoporosis and local factors related to the surgical peri-implant site might increase the severity of the peri-implant tissues destruction. In addition, several other factors exist, such as poor implant placement, poor oral hygiene, residual cement, poor implant surface, unfavorable osseous density, untreated periodontitis, drinking and smoking, untreated endodontic lesions, diabetes, etc and can cause peri-implant disease. Smoking is the greatest and most often cited risk factor for peri-implant disease followed by a history of periodontitis. Bone tissue factor associated with appearance of peri-implantitis are mineral bone density, microarchitecture and trabecular thickness. Also the distance between the contact point between two neighboring teeth and a line connecting the mid-facial soft tissue margin of these teeth can be categorized as important risk factor for peri-implanitis and mucositis. Surgical trauma has been regarded as one of the most commonly suspected etiologies proposed for peri-implantitis. Occlusal overload can result in progressive marginal bone loss or even complete loss of osseointegration, and when traumatic occlusion is combined with inflammation, the progression of bone destruction is accelerated. Mechanical debridement, disinfection with chemotherapeutic agents, smoothing implant surface and surgeries aimed to eliminate. Healthy periodontal environment is absolutely required after decontamination of implant surface to achieve desirable treatment outcomes. Based on the most up-to-date data from scientific and expert research investigations processed for the purpose of this paper, it can be observed that the following etiological and risk factors are of major importance in the development of peri-implantitis: presence of dental plaque; inadequate oral hygiene; smoking; adverse occlusal loading ect.
Keywords: peri-implantitis, etiology, risk factors, peri-implant disease.

1. INTRODUCTION: DEFINITION OF PERI-IMPLANITIS

In contemporary dental medicine, the usage of dental implants to restore partial and totally edentulous patients is very successful treatment. Peri-implantitis as an inflammatory process leads to a loss of supporting alveolar bone around an osseointegrated implant.

The biggest complication in implant dentistry can be last-stage infection, after the implant is well-osseointegrated in the alveolar bone. There are two types of infections that can be found around an osseointegrated implant: peri-implantitis and mucositis. (Zitzmann & Berglundh, 2008)

Mucositis is an infection of the soft tissues around the abatmen - suprastructure - implant complex, especially on the cervical third of the dental implant. Peri-implantitis is an infection around the body or the apex of the implant

followed by less or bigger alveolar bone loss around the implant. These two different conditions are characterized by an inflammatory response to anaerobic bacteria from the plaque biofilm found of the implant or suprastructure surfaces. It must be noted that even an implant with a successful osseointegration can develop the most common late failure complication, known as peri- implantitis. (Mellado-Valero et al, 2013)
According to abovementioned, peri-implantitis as an inflammatory process caused from a microbial origin can lead to bone loss and if not treated could lead to the complete loss of the implant-supported prosthodontic restoration. Clinically, the inflammatory process can be presented as bleeding on probing, deepened periodontal pockets and periodontal suppuration. (Ata-Ali et al, 2015)
Currently, there is no standard treatment for peri-implantitis and clinicians are faced with a numerous treatment choices. Hence, the prevention and maintenance of proper oral hygiene are the most important in the treatment of these types of peri-implant diseases. Thus, the chances of such complications would be reduced significantly. (Smeets at al, 2014)

2. EPIDEMIOLOGY OF PERI- IMPLANTITIS

The most common data for the incidence of peri-implant diseases is that the range is between 0.5% and 43% after 5 years. According to Mombelli, Müller and Cionca (2012) prevalence of peri-implantitis seems to be in the range of 10% from all placed implants and among 20% of the patients during period of 5-10 years after implant placement. According to Dreyer et al (2018), the prevalence of peri-implantitis on implant level ranged from 1.1% to 85.0% and the incidence varies from 0.4% within 3 years, to 43.9% within 5 years, respectively. The median prevalence of peri-implantitis according to same authors is 9.0% for regular participants of a prophylaxis program, 18.8% for patients without regular preventive maintenance, and 11.0% for non-smokers, 7.0% among patients representing the general population, 9.6% for patients provided with fixed partial dentures, 14.3% for subjects with a history of periodontitis. The prevalence of peri-implantitis according to one big literature review done by Charalampakis et al ranged from 10 to 40 %. (Charalampakis, Jansåker& Roos-Jansåker, 2014)
On this place must be noted that the data on the presence of peri-implantitis and mucositis in our country and the surrounding countries are extremely rare. Therefore in this paper lacking data about the prevalence of such forms of diseases in our population.
Taking into consideration that peri-implantitis, as an inflammatory condition, can lead to implant loss and consecutively loss of the prosthetic suprastructure worn by the implants, we set out the main aim of this paper - to analyze the latest available literature data concerning the etiology of peri- implantitis.
Adequate literature research was performed to fulfill the main goal. Sources of information used in this study are obtained from the most used of all scientific databases- PubMed. The keywords used for searching in this database were “peri-implantitis etiology”, “etiology of peri-implantitis”, “peri-implant disease etiology” and “risk factors peri-implantitis”.
All of the used literature was previously published in peer-reviewed publications and journals. Most of the articles were in English language, published in the last fifteen years from 2004 until 2019.

3. ETIOLOGY OF PERI- IMPLANTITIS

Given the fact that the number of patients treated with dental implants is increasing and continues to grow worldwide, dentists must be ready for the challenges that these sometimes complex restorations carry with them, especially with the complications associated with them. Proper monitoring and maintenance of the implants and their suprastructures in the patient's mouth is essential to ensure the longevity of the dental implant therapy. This can only be achieved through a combination of adequate and regular dental check-ups, proper oral care and effective oral hygiene performed by the patient. (Valente & Andreana, 2016). Because of the great possibility of dental implants’ failures in oral implantology, it is very important to monitor and to reduce the possibility for peri-implantitis appearance at any stage of the implant treatment, and also if this infection appeared to be treated as soon as possible.
In order to prevent the occurrence of peri-implantitis, it is necessary to be familiar with all the factors that may lead to its occurrence. Understanding the etiological and risk factors leads to successful prevention of this late-stage complication.
Peri-implantitis can be defined as a poly-microbial anaerobic infection around the body or the apex of the implant. The etiology of peri-implantitis is associated with a complex bacterial dental biofilm and numerous risk factors. All these bacteria from the dental biofilm can establish harmful inflammatory immune response in host and inhibits bone cells reattachment to the implant surface. (Lasserre, Brecx, & Toma,2018)
Peri-implantitis is a host immune system response against specific types of anaerobic bacteria present in subgingival plaque accumulated around dental implant. This accumulation can lead to inflammation and at the end cause

connective tissue destruction. Initially this reaction leading to peri-implant mucositis which is clinically presents as inflammation of the gingiva around the dental implant. Later this can lead to progressive destruction of surrounding tissue and causing peri-implantitis. (Correa et al, 2019)

Microorganisms that are living on the dental implant surface are initial cause of peri-implantitis. Most common detected pathogenic microorganisms in peri-implant lessions are Prevotella intermedia, Prevotella nigrescens, Streptococcus constellatus, Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, Treponema denticola and Tannerella forsythia. (Pokrowiecki et al, 2017) Especially it should be noted that, Staphylococcus aureus play a predominant role for the development of a peri-implantitis, especially the most advanced forms of peri-implantits. This bacterium shows a high affinity to titanium according to the results published by Salvi, Monje, & Tomasi.(2018)

The microorganisms less founded in the lesions caused by peri-implantitis are enteric bacteria, Peptostreptococcus micros and Candida spp. From ecological aspect must be noted that deep pockets caused by peri-implantitis are suitable environment for growth of obligate anaerobes (such as Gram negative rods) and gram positive assacharolytic anaerobic bacteria which are also microorganism connected to the development of peri-implantitis. (Zheng et al, 2015)

Previous periodontal disease, poor oral hygiene, tobacco usage, genetic traits, diabetes, residual cements and occlusal overload are most common noted risk indicators. Other potential risk factors such as osteoporosis and local factors related to the surgical peri-implant site might increase the severity of the peri-implant tissues destruction. (Poli et al, 2016) There is a strong similarity between chronic periodontitis and peri-implantitis. Both periodontitis and peri-implantitis are caused by bacterial infection by microorganisms hosted in a biofilm and show similar clinical features such as inflammation of the soft tissues and the appearance of defects in the alveolar bone where the teeth or dental implants are placed. (Maruyama et al, 2014)

But what has to be noted is that inflammation of the peri-implant tissues mostly develops more easily than that of the periodontal tissue, probably due to the fact that attachment between the implant body and the gingiva is weaker than the connection of the gingiva and a natural teeth. Therefore maintaining oral hygiene around the implants is extremely important to reduce the negative effects of the dental biofilm, and consequently for their longevity.

Because of the extreme closeness in the microflora and pathogenesis, risk factors for periodontal disease need to be evaluated especially when implant placement is done among these patients. This is especially important in the post-implant placement period, in the maintenance phase of the achieved results and of course when the evaluation of the success of the implant therapyis done. (Zheng et al, 2015) In low-risk individuals, simple prophylactic procedures are sufficient, and the quantum of the dental plaque and microbiota can be easily minimized. This is not the case in people with moderate or severe periodontal disease who require periodontal therapy and more frequent checkups to achieve and maintain adequate oral hygiene and periodontal health. In recent studies, Rodriguez et al (2018) found that bacterial biofilms attached onto the surface of implants can create a highly acidic environment that causes corrosion, pitting, cracking on the implant surface etc. Furthermore, new studies have shed light on the release of titanium ions from the implant surface, which causes a significant increase in local inflammatory effect.

Plaque accumulation around dental implants must be noted as major factor associated with the development of peri-implant mucositis. Presence of untreated or insufficiently treated endodontic infections adjacent to the site of implant placement can adversely affect the outcome. (Esfahrood et al, 2012)

Although bacterial insult is identified as the main cause of peri-mucositis, peri-implantitis is considered to be initiated by stress factors caused by a poor biomechanical environment. So, except the anaerobic microorganism living in the oral biofilm, inadequate occlusion of the suprastructures is indicated by many studies as a cause of peri-implant disease. Unfavorable stress factors can initiate crestal bone loss, and bacterial presence can further propagate the rate of osseous destruction. (Bertolini et al, 2019)

Several other factors exist, such as poor implant placement, poor oral hygiene, residual cement, poor implant surface, unfavorable osseous density, untreated periodontitis, drinking and smoking, untreated endodontic lesions, diabetes, etc can cause peri-imlant disease.

In addition to patient training sessions for optimal oral hygiene, preventive strategies such as professional tooth and implant cleaning as well as individually continuous peri-implant examinations (probing status) should be considered in order to prevent peri-implant diseases contributing etiologic factors such as:

1) Plaque;
2) Oral hygiene;
3) Smoking;
4) Adverse loading;
5) Non-surgical debridement;
6) Use of mouth rinses;

7) Use of systemic antibiotics; and
8) 3-month supportive care for treatment of peri-implantitis. (Kandasamy et al, 2018)

Among the risks factors contributing to dental implant loss are patients with poor oral care and periodontitis, smokers, anatomical factors such as poor soft tissue thickness and bone quality at the time of dental implant placement, poor surgical procedures and old history of failure related to dental implant.

Smoking is the greatest and most often cited risk factor for peri-implant disease followed by a history of periodontitis. Also, smoking is noted as a predictor for implant failure. Tobacco negatively affects the outcome of almost all therapeutic procedures performed in the oral cavity. However, it was suggested that increased implant failure among smokers is not the result of inadequate healing process or poor osseointegration, but because of exposure of peri-implant tissues to tobacco smoke. (Balaji, 2016)

Diabetes mellitus because suboptimal metabolic control of glucose often is contributed with wound-healing difficulties and have an increases susceptibility to peri-implant infections due to a variety of problems associated with immune and metabolic dysfunctions. That is why this systemic condition is most often placed in this group of risk factors. (Valente & Andreana, 2016).

Bone tissue factor associated with appearance of peri-implantitis are mineral bone density, microarchitecture and trabecular thickness. Also the distance between the contact point between two neighboring teeth and a line connecting the mid-facial soft tissue margin of these teeth can be categorized as important risk factor for peri-implanitis and mucositis. (Schminke, 2015)

Surgical trauma has been regarded as one of the most commonly suspected etiologies proposed for peri-implantitis. Occlusal overload can result in progressive marginal bone loss or even complete loss of osseointegration, and when traumatic occlusion is combined with inflammation, the progression of bone destruction is accelerated. (McCrea, 2014)

The relationship between these inflammatory changes in the soft tissues and subsequent progression to involve bone loss that is observed in peri-implantitis is not clarified. An early study, which compared the microbiota surrounding successful and failing titanium implants, found that failing sites had a significantly higher proportion of micro-organisms traditionally associated with periodontal diseases. The clinical implication is, if traditional periodontal pathogens are found, then the disease process could be similar to periodontal disease and patients with a history of chronic periodontitis may be at increased risk of peri-implantitis. It is suggested, that the microbiology associated with implants are related to the bacteria already resident in the oral cavity, that is, that the remaining teeth can act as reservoirs for seeding of bacteria in the peri-implant tissues. (Casado et al, 2013)

Mechanical debridement, disinfection with chemotherapeutic agents, smoothing implant surface and surgeries aimed to eliminate. Healthy periodontal environment is absolutely required after decontamination of implant surface to achieve desirable treatment outcomes. Failure in controlling plaque index in most of the studies can be a serious confounding factor that led to inconsistencies in the result. (Monje, Insua & Wang, 2019)

4. CONCLUSION

Based on the most up-to-date data from scientific and expert research investigations processed for the purpose of this paper, it can be observed and concluded that the following etiological and risk factors are of major importance in the development of peri-implantitis: presence of dental plaque; inadequate oral hygiene; smoking; adverse occlusal loading; use of mouthrinses and of systemic antibiotics and 3-month supportive care for treatment of peri-implantitis.

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